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Atty. Docket No. KOV-004
Serial No: 10/616,147

Remarks

Applicants and their undersigned representative thank Examiner Trinh for the careful review of the present application, the detailed explanations in the Office Action dated September 8, 2006, and the helpful and courteous discussion held with the undersigned on October 3, 2006. As discussed, the claims have been amended to focus the invention on printing and curing a pattern to form a patterned semiconductor film comprising an array of lines having particular width, length, and thickness dimensions. Although the cited references disclose printing such a composition in general terms, they do not disclose or suggest printing such an array of lines. For example, the primary reference is concerned with making coatings for solar cells. As a result, the primary reference provides no real motivation to one of ordinary skill in the art to print and cure a similar composition in a pattern comprising an array of such lines. The secondary references fail to cure this deficiency of the primary reference. The following remarks shall further summarize and expand upon topics discussed.

The present invention relates to a method of making a patterned semiconductor film, comprising the steps of:

a) inkjet printing, gravure printing, printing by offset lithography, or flexographic printing a composition comprising a first cyclic Group IVA compound of the formula (1):

$$(AH_x)_n, \qquad (1)$$

where n is from 3 to 8 and each A in the formula is independently Si or Ge, and/or a second cyclic Group IVA compound of the formula (2):

$$(AH_x)_m(AH_yR_{x-y})_p(ZR')_q, \qquad (2)$$

where (m + p + q) is from 3 to 12, each of the m instances of x is independently 0, 1 or 2, each of the p instances of y is independently 0, 1 or 2, each of the p instances of z is independently 0, 1 or 2, each of the p instances of (y + z) is independently 1 or 2, each of the q instances of w is independently 0 or 1, at least one of p and q is at least 1, each A in the formula (2) is independently Si or Ge, Z

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is selected from the group consisting of B, P and As, R' is R or H, and each R in the formula (2) is independently alkyl, aryl, aralkyl, a halogen, $BH_sR"_{2-s}$, $PH_tR"_{2-t}$, $AsH_sR"_{2-s}$ or $AH_tR"_{3-t}$, where s is 0 to 2, t is 0 to 3, and R" is alkyl, aryl, aralkyl, a halogen, or AH_3, and a solvent in a pattern on a substrate; and

b) curing the printed composition to form the patterned semiconductor film, wherein curing the printed composition comprises irradiating the printed composition, and the patterned semiconductor film comprises an array of lines having a width of from 100 nm to 100 μm, a length of from 1 μm to 5000 μm, and a thickness of from 0.01 μm to 1000 μm.

The references cited against the claims (Shiho et al., U.S. Pat. Appl. Publ. No. 2003/0045632 [hereinafter "Shiho"], Jacobson et al., U.S. Pat. No. 6,294,401 [hereinafter "Jacobson"], Bulthaup et al., U.S. Pat. No. 6,936,181 [hereinafter "Bulthaup"], and Tani, U.S. Pat. No. 5,254,439 [hereinafter "Tani"]) neither disclose nor suggest printing a silane-containing composition by inkjet printing, gravure printing, offset lithography, or flexographic printing, then curing such a printed composition by a process including irradiating the printed composition to form a patterned semiconductor film comprising an array of lines having a width of from 100 nm to 100 μm and a length of from 1 μm to 5000 μm. Consequently, the present claims are patentable over the cited references.

The Rejection of Claims 41-47 and 55-61 under 35 U.S.C. § 103(a)

The rejection of Claims 41-47 and 55-61 under 35 U.S.C. § 103(a) as being unpatentable over Shiho in view of Jacobson has been obviated by appropriate amendment.

The limitations of Claims 62, 64 and 65 have been incorporated into independent Claim 41. Therefore, this ground of rejection is unsustainable, and should be withdrawn.

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The Rejection of Claims 48-50 and 62-65 under 35 U.S.C. § 103(a)

The rejection of Claims 48-50 and 62-65 under 35 U.S.C. § 103(a) as being unpatentable over Shiho in view of Jacobson, and further in view of Bulthaup is respectfully traversed.

Shiho discloses a silane composition for preparing a semiconductor thin film of a solar cell. The silane composition contains a polysilane compound represented by the formula Si_nR_m (n is an integer of 3 or more, m is an integer of n to (2n+2) and R is independently a hydrogen atom, alkyl group, phenyl group or halogen atom, with the proviso that when all of the R's are hydrogen atoms and m = 2n, n is an integer of 7 or more), and at least one silane compound selected from cyclopentasilane, cyclohexasilane and silylcyclopentasilane (Abstract). The silane composition of Shiho may further contain silicon particles (component (C); see paragraphs [0058]-[0064]). Shiho teaches that a silicon film can be formed by forming a coating film of the first or second silane composition on the substrate and then treating it with heat and/or light in a non-oxidizing atmosphere (see paragraphs [0105]-[0106]).

Shiho also teaches that the coating film can be treated with light to convert it into a silicon film or silicon oxide film, and that a silicon film or silicon oxide film having a desired pattern can also be formed by exposing part of the coating film selectively using a photomask having a desired pattern (see paragraph [0127]). Shiho further teaches that the conductive film and insulating film may be formed and patterned before use, in which case they may be patterned by a general method such as masking or lithography, or by an ink jet method (see paragraph [0153]). However, Shiho is silent with regard to the length and width dimensions of lines formed in such a pattern, which makes sense since Shiho is primarily concerned with making coatings for solar cells (see, e.g., paragraphs [0128]-[0152] of Shiho).

Therefore, Shiho does not disclose or suggest irradiating or curing a silane-containing composition printed by inkjet printing, gravure printing, offset lithography, or flexographic printing to form a patterned semiconductor film comprising an array of lines having a width of from 100 nm to 100 μm and a length of from 1 μm to 5000 μm, as recited in the present Claim 41. Consequently, Shiho is deficient with regard to the present claims.

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Jacobson does not cure the deficiency of Shiho.

Jacobson discloses nanoparticles that are utilized to create, through deposition and patterning, functional electronic, electromechanical, and mechanical systems (Abstract, ll. 1-3). Monodisperse or polydisperse nanoparticles can form stable colloids or suspensions in appropriate dispersing media, facilitating their deposition and processing in a liquid state. As a result, printing technology can be utilized to deposit and pattern nanoparticles for mass production or for personal desktop manufacturing (Abstract of Jacobson, last 7 lines).

Jacobson discloses that electromagnetic radiation, such as from a heat lamp or laser, may be used to thermally convert nanoparticles to their bulk state (col. 6, ll. 32-35), but Jacobson is silent with regard to silane compounds, such as those of the formulas (1) and (2) in the present Claim 41. Also, like Shiho, Jacobson is silent with regard to the widths and lengths of lines in any printed and/or cured pattern. As a result, Jacobson cannot cure the deficiency of Shiho with regard to irradiating or curing a silane-containing composition printed by inkjet printing, gravure printing, offset lithography, or flexographic printing to form a patterned semiconductor film comprising an array of lines having a width of from 100 nm to 100 μm and a length of from 1 μm to 5000 μm, as recited in the present Claim 41.

Bulthaup fails to cure the deficiencies of Shiho and Jacobson.

Bulthaup discloses a method of patterning a surface or layer in the fabrication of a micro-device (Abstract, ll. 1-2). However, like Jacobson, Bulthaup is silent with regard to silane compounds, such as those of the formulas (1) and (2) in the present Claim 41. Also, like both Shiho and Jacobson, Bulthaup is silent with regard the widths and lengths of lines in the printed, cured pattern. As a result, Bulthaup cannot cure the deficiencies of Shiho and Jacobson with regard to irradiating or curing a silane-containing composition printed by inkjet printing, gravure printing, offset lithography, or flexographic printing to form a patterned semiconductor film comprising an array of lines having a width of from 100 nm to 100 μm and a length of from 1 μm to 5000 μm, as recited in the present Claim 41.

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Consequently, no possible combination of Shiho, Jacobson and Bulthaup can disclose or suggest irradiating or curing a silane-containing composition printed by inkjet printing, gravure printing, offset lithography, or flexographic printing to form a patterned semiconductor film comprising an array of lines having a width of from 100 nm to 100 μm and a length of from 1 μm to 5000 μm, as recited in the present Claim 41. Therefore, this ground of rejection is unsustainable, and should be withdrawn.

The Rejection of Claims 51-54 under 35 U.S.C. § 103(a)

The rejection of Claims 51-54 under 35 U.S.C. § 103(a) as being unpatentable over Shiho in view of Jacobson and Bulthaup, and further in view of Tani is respectfully traversed.

As discussed above, the combination of Shiho, Jacobson and Bulthaup is deficient with regard to irradiating or curing a silane-containing composition printed by inkjet printing, gravure printing, offset lithography, or flexographic printing to form a patterned semiconductor film comprising an array of lines having a width of from 100 nm to 100 μm and a length of from 1 μm to 5000 μm, as recited in the present Claim 41. Tani fails to cure the deficiencies of Shiho, Jacobson, and Bulthaup.

Tani discloses a polymer having linear --Si--O--Si-- bonds and --Si--Si--Si-- bonds, or polysilane bonds that are greater than trisilane bonds, sensitive to far ultraviolet rays (Abstract, ll. 1-4). The polymer undergoes oxidation with oxygen plasma to form SiO_2 that is resistant to oxygen dry etching, exhibits absorption peaks only in far ultraviolet, and suitable for preparing a single layered resist or an upper resist of a two-layered system (Abstract, last 5 lines).

Tani also discloses a rotary-coated upper resist layer 3, selectively irradiated with pulses of KrF excimer laser rays 4 (248 nm) through a mask carrying a desired pattern (see col. 6, ll. 11-21 and FIG. 2(c) of Tani). Then, the exposed portions of the layer 3 were developed with ethanol to remove the same and to thus form a positive working upper resist pattern 3a (see col. 6, ll. 21-24 and FIG. 2(d) of Tani).

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However, Tani does not appear to disclose *cyclic* Group IVA compounds of the formulas (1) or (2), particularly in which the substituents bound to the Group IVA atoms are predominantly H (e.g., the present formula (2)) or exclusively H (e.g., the present formula (1)). Also, Tani appears to be silent with regard to printing. As a result, like Shiho, Jacobson and Bulthaup, Tani is necessarily silent with regard the widths and lengths of lines in any printed, cured pattern.

Consequently, no possible combination of Shiho, Jacobson, Bulthaup and Tani can disclose or suggest irradiating or curing a silane-containing composition printed by inkjet printing, gravure printing, offset lithography, or flexographic printing to form a patterned semiconductor film comprising an array of lines having a width of from 100 nm to 100 μm and a length of from 1 μm to 5000 μm, as recited in the present Claim 41. Therefore, this ground of rejection is unsustainable, and should be withdrawn.

The Objections to the Claims

The objections to the claims have been overcome by appropriate amendment.

Conclusions

In view of the above amendments and remarks, all bases for objection and rejection are overcome, and the application is in condition for allowance. Early notice to that effect is earnestly requested.

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If it is deemed helpful or beneficial to the efficient prosecution of the present application, the Examiner is invited to contact Applicant's undersigned representative by telephone.

Respectfully submitted,

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